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Physical Therapy and Above-Knee Amputation Pre-Prosthetic Rehabilitation: A Case Report

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PHYSICAL THERAPY AND ABOVE-KNEE AMPUTATION PRE-PROSTHETIC REHABILITATION: A CASE REPORT

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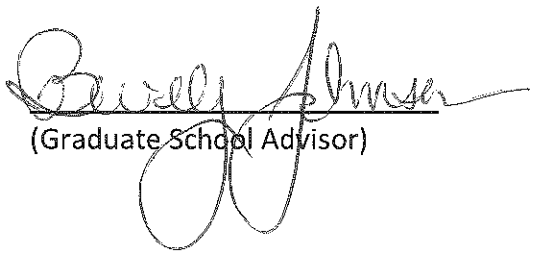

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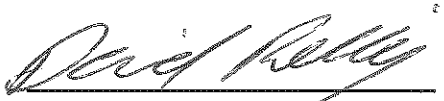

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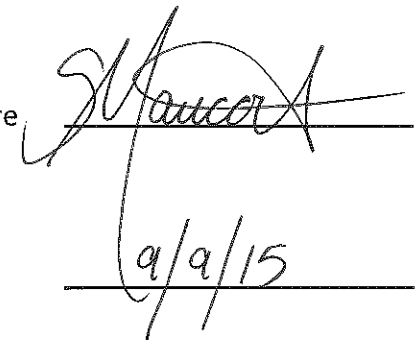
Signature 

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ABSTRACT

Background and Purpose: Promotion of functional mobility through surgical and therapeutic interventions has seen a dramatic increase within the past decade due to the aging population and increased push for objective functional assessment data. A key to obtaining optimal functional performance is core stability and this can be applied to individuals with a variety of limitations including an amputation. The purposes of this case study are to look at the pre-prosthetic rehabilitation regimen of an individual with an above-knee amputation and discuss the importance of key elements that should be present in a pre-prosthetic training program to allow a patient optimal use with a prosthetic limb.

Case Description: The case study relates to the pre-prosthetic rehabilitation of a 53 year old morbidly obese male who underwent an above-knee amputation (AKA). The patient had a history of a motorcycle accident in 2007 that resulted in multiple surgeries, including TKA, confining him to primarily wheelchair mobility. The patient continued to have chronic pain and ultimately had an AKA in 2014.

Intervention: Pre-prosthetic rehabilitation included physical therapy interventions such as patient education, residual limb shaping and desensitization, and therapeutic exercises focusing on gait training, residual limb strengthening and restoration of optimal lower extremity range of motion.

Outcomes: The rehabilitation of the residual limb was successful in regards to favorable shaping and desensitization. Limitations remained for full knee extension by 25°. The patient's inability to complete self-care activities of daily living necessitated discharge to assisted living approximately twenty weeks post-amputation. Successful ambulation for distances of 170 feet with prosthetic limb and a standard walker was achieved at time of discharge.

Discussion: Key elements of a successful pre-prosthetic rehabilitation program were absent from this patient's care including a diagnosis specific functional assessment such as the Amputee Mobility Predictor (AMP), and a core stabilization regimen. The incorporation of these components in the patient's rehabilitation may have aided the patient in reaching functional mobility with a lower extremity prosthetic limb. The patient had superb compliance in wearing an elastic shrinker sock and completing mirror therapy assisting in favorable residual limb rehabilitation and reduction of phantom limb pain.

CHAPTER I

BACKGROUND AND PURPOSE

Core stabilization exercises are commonly integrated into physical therapy treatment targeting a functional impairment. Core stabilization exercises provide benefits for a wide variety of clients attending physical and occupational therapy including those suffering from low back pain and balance deficits. Another population who may benefit from core stabilization exercises are those individuals who have had an amputation. The purposes of this case report are to look at a patient with an above-knee amputation and his pre-prosthetic rehabilitation regimen and to discuss key elements that should be present in a pre-prosthetic training program to allow for optimal mobility with a prosthetic limb.

The older population has been on a steady increase throughout the past century. In 2011, the baby boomer generation began turning 65, causing a spike in the 65 and older population. By 2030, the older population is projected to be nearly twice as large as their counterparts in 2000.[1] These statistics are important to consider from a health care perspective, as there are many implications this shift will have throughout the medical world. One implication is the increase in the number of surgeries such as a total joint arthroplasties, specifically total knee arthroplasty (TKA) due to age-related conditions of the skeletal system such as osteoarthritis (OA). Between the years 1991 and 2010, annual primary TKA volume increased 161.5%.[2] In 2010, osteoarthritis was stated to be the most common joint disorder in

the United States. The prevalence rates of symptomatic OA is approximately 10% in men and 13% in women.[2] With the older population growing at an immensely higher rate today versus 20 years ago, there are many parts of health care that will see changes including increased prevalence of aging-related surgical procedures. With the expected increase in TKA procedures, many patients will hope to return to increased functional mobility with decreased pain.

Unfortunately, this is not the case for all patients who have to undergo a surgical procedure. Amputation is a devastating operation that is part of health care. Occasionally TKA and amputation can go hand in hand when complications arise. The incidence of an above-knee amputation (AKA) after a TKA is very low, with a percentage of incidence less than 1%.[3,4] Recurrent infections is the leading cause of amputation due to TKA complications, with an incidence of 75-80%.[3,4] According to research, an AKA is associated with limited functional abilities and a poor to very poor prognosis on the ability to walk independently after the procedure.[3,4] In 2003, Sierra et al[3] conducted a study looking at the prevalence and outcomes of patients who underwent an AKA after a complicated TKA. Of the 19 patients in the study, only 3 (16% of individuals with an amputation) were able to ambulate with a prosthesis. Another study, completed in 2012 by Mozella et al[4] had 16 patients who underwent an AKA as a consequence of failure or complications from a previous TKA. Of those 16, only 7 (44% of individuals with an amputation) were fitted with a prosthetic device and were able to walk with use of crutches with the exception of one independent ambulator. While research shows that many individuals have limited functional abilities after an AKA due to complications following TKA, this does not have to be the case. Physical therapy is a key player in the rehabilitation of individuals with an amputation and the promotion of functional mobility.

Figure 1. Mirror Therapy

A goal worth achieving does not come without its difficulties. An obstacle a patient with an amputation may have to overcome is phantom limb pain as 50-85% of patients with an amputation experience ongoing phantom limb pain.[5] Phantom limb pain is pain that feels like it is coming from a body part that has been amputated. It was once believed that this post-amputation phenomenon was a psychological issue, but experts now recognize that these sensations originate in the spinal cord and brain.[6] The areas representing the phantom limb within the primary motor and sensory cortices that no longer receive adequate afferent input are invaded by adjacent regions creating a painful response.[5] Pain is the basic message used to communicate when something is not right in the body.[6] A treatment method commonly used is mirror therapy, demonstrated in Figure 1[7]. This treatment involves placing the affected limb next to the mirror and then looking into the mirror while making movements with the sound limb. This makes it possible for the patient to perceive movement in the phantom limb.[8] Mirror therapy may offer relief to patients experiencing phantom limb pain as this treatment exploits the brain's preference to prioritize visual feedback over somatosensory or proprioceptive feedback concerning an extremity's position.[8] In 2014, a systematic review was completed by Deconinck et al[9] to look at the effects of mirror visual feedback (MVF) on the brain. Their results state that MVF increases neural activity in areas involved with allocation of attention and cognitive control. They concluded that MVF can exert a strong influence on the motor network, mainly through increased cognitive penetration and action control. MVF is rationalized as a

form of treatment for phantom limb pain based on the notion of a mismatch between motor output and visual and/or proprioceptive feedback.[9] In 2015, Timms and Carus[5] published a literature review concerning mirror therapy and the alleviation of phantom limb pain. The review concluded that mirror therapy is a promising and low-cost treatment for phantom limb pain and can not only help alleviate pain, but it also may help individuals gain control of their phantom limb to further help attenuate pain. As stated previously, phantom limb pain is likely caused by a mismatch of signals occurring in the brain and the reorganization taking place. Timms and Carus found that visual feedback via mirror therapy has the potential to reverse sensorimotor cortical reorganization after an amputation which can subsequently reduce phantom limb pain. However, through activity shown on fMRIs, differences with cortical involvement suggests that phantom limb pain experiences are individual to the patient.[5] Despite 20 years of utilizing mirror therapy as a form of treatment with evidence that can only be described as weak, many individuals with an amputation continue to find relief of their phantom limb pain through the incorporation of mirror therapy into their rehabilitation.[5,6,8-10]

Promoting functional mobility is an essential part of health care and can greatly impact one's quality of life. Research shows functional mobility and quality of life are related to one another.[11-13] A study completed by Paker et al[11] aimed to investigate the effects of robotic treadmill training on functional mobility in individuals with Parkinson's disease. A secondary aim of the study was to assess the effects of the treadmill training on the patient's motor systems and their quality of life. The study concluded that robotic treadmill training was useful to improve functional mobility and also provided a transient improvement in the quality of life of the patients during the treatment. Another study completed by Király and Gondos[12] aimed to

analyze the relationship between the movement and health-related quality of life indicators after a total hip replacement. The effects of movement parameters on subsequent feelings of well-being had not been examined prior to this study. The study concluded that a successful total hip replacement procedure improved the feeling of well-being and the mobility function of patients even five years after their operation. These examples help show why the promotion of functional mobility is an indispensable goal of health care; to help improve patients' quality of life.

The push for increased functional mobility has led to the development and utilization of functional outcome measures to provide objective data to show an individual's improvements and to justify a specific plan of care.[14] With the dramatic increase in the use of functional outcomes measures within the past decade, there has been development of an assessment specific to those individuals with an amputation. "The Amputee Mobility Predictor (AMP) is currently the only functional assessment that has demonstrated the ability to determine functional level and predict functional ability for people with a lower limb amputation."[15] The Amputee Mobility Predictor was designed to measure an individual's functional capabilities without a prosthetic limb and to predict their ability to ambulate with a prosthesis.[16]

While a functional measure such as the AMP is a significant factor in an individual's pre-prosthetic rehabilitation, perhaps the most imperative component is the rehabilitation itself. An individual with an AKA has a much poorer prognosis than those individuals with a transtibial or transmetatarsal amputation in the matter of functional ambulation post-amputation.[3,4] A key difference between an individual who has an AKA and a lower-level amputation is the energy expenditure while walking. Dr. Robert Waters[17] explains that as more joints and muscles of the

leg are taken away due to higher-level amputations, a greater loss of an individual's normal locomotor mechanisms is seen. This leads to more compensation, less efficient gait pattern and higher oxygen cost than those with lower-level amputations. Meier and Melton[18] also found that individuals with an AKA have the highest increased energy expenditure, expending 60-70% more energy than normal.

Meier and Melton have also summarized ideal functional outcomes for amputation levels. They explain that pre-prosthetic training begins with desensitization, residual limb shrinking and prevention of contractures by maintaining range of motion of lower limb joints. Another important component that should be incorporated into an individual's pre-prosthetic training is the mastery of weight shifting and balance activities.[18] Some examples for ideal functional outcomes include standing for up to 2 continuous hours, sitting for up to 2 continuous hours, and arising from a kneeling position.[18] For a patient to be able to complete these tasks after a procedure such as an amputation, significant strengthening will have to take place.

Core strengthening exercises are essential when aiming to improve balance. In 2013, Chung et al[19] conducted a study to determine the effects of core stabilization exercise on dynamic balance and gait function in individuals post-stroke. Participants were split into two groups and received general training five times a week. One group practiced an additional core stabilization exercise program. All individuals were evaluated for dynamic balance (Timed Up and Go Test (TUG)) and gait parameters (velocity, cadence, step length and stride length). Their results showed the core exercise group saw a significant change in TUG, and gait velocity and cadence. Another study looked at the improvements in dynamic balance and core endurance

after a 6-week core-stability-training program in high school track and field athletes. Participants were evaluated using the Star Excursion Balance Test (SEBT), abdominal-fatigue test (AFT), back-extension test (BET), and side-bridge test (SBT). The design of the study was test-retest. The authors' conclusion stated that after a 6-week core-stability-training program participants demonstrated increased dynamic balance in the medial and anteromedial reach directions and improved core endurance.[20]

Literature regarding the effects of core stabilization exercises on individuals with an amputation is relatively limited. One study by Corio et al[21] in 2010 aimed to determine whether improvements in the spatial and temporal parameters of gait would be observed after an 8-week spinal stabilization program in individuals with lower limb loss. The primary outcome measures of gait parameters included base of support (BOS), step length, velocity and cadence determined with a GAITRite System. Significant improvements were seen among individual gait parameters including the amputated side step length and stride length, sound side stride length and overall velocity. Individuals with an AKA have many obstacles to overcome to reach a level of optimal functioning after their procedure. Core stabilization exercises may help an individual with an amputation overcome these obstacles and reach optimal functioning with their prosthetic limb.

There is little evidence in research today to demonstrate the benefits of implementing core stabilization exercises into a patient's pre-prosthetic rehabilitation regimen in individuals who have an AKA. The influence of proper core strength on functional outcomes is also an area with limited data. As core strengthening is a vital piece in many physical therapy sessions for various impairments, it is concerning how minimal literature can be found regarding core

strength for individuals following an amputation. With the loss of a limb, a patient must relearn a variety of aspects of their life including dressing, walking and many other basic activities of daily living. The purposes of this case report are to look at the pre-prosthetic rehabilitation regimen of an individual with an AKA and discuss the importance of key elements that should be present in a pre-prosthetic training program to allow a patient with a lower extremity prosthetic device optimal functional mobility.

CHAPTER II

CASE DESCRIPTION

A. Patient History

The patient was a 53 year old male navy veteran and was seen in physical therapy throughout the fall of 2014. He was referred to physical therapy due to the anticipation of an impending above-knee amputation. This patient's amputation procedure and resulting physical therapy treatment were completed at a medical facility that was far from the patient's hometown. The patient had a complex and mysterious social background; it was never clear to this therapist how he ended up at the medical facility where he ultimately had an AKA on the right side. The patient had no family or social support near the facility and had never visited the city prior to 2014. The patient's related medical history started 7 years prior, in 2007, when he was victim to a motorcycle accident and sustained multiple injuries. The most noteworthy injury was to his right knee, which ultimately required a TKA. The patient subsequently had recurrent infections in the right lower extremity leaving him in severe pain.

Chronic pain following TKA complications required high-strength narcotic/opioid pain killers for relief, which led to addiction. Severe pain in his right knee left the patient confined to a wheelchair for long distance mobility since the time of his motorcycle accident in 2007, and served as the trigger that brought him to the medical facility initially in July 2014. After evaluation by physicians and surgeons and discussion with the patient, amputation was the

solution offered to ease the pain from the recurrent infections related to the TKA hardware. Amputation offered the patient the possibility to walk again someday without the use of an assistive device. The AKA on the right was completed 13 days after the patient's admission to the facility.

B. Examination and Evaluation

The patient chose to move forward with the amputation, driven by the hopes of becoming ambulatory again with a new prosthetic limb and no additional assistive devices. This prompted the initial physical therapy evaluation. The patient was a morbidly obese male with a BMI of 47 and had a history of a total hip arthroplasty (THA) on the left. Upon arrival at the medical facility, the patient's medical record was updated indicating that the patient had comorbidities including hypertension, anxiety and a history of narcotic/opioid abuse. The patient explained that prior to his motorcycle accident in 2007, he was employed by United Postal Service (UPS®). He briefly described his responsibilities including driving the delivery trucks, but explained that injuries sustained in the motorcycle accident prevented him from successfully being employed in this capacity. Prior to admission to the facility, the patient explained that he required a wheelchair for long-distance mobility and a walker for short distances in his home.

The patient's mobility was assessed upon initial evaluation prior to his amputation. The patient was independent in bed to chair transfers and ambulation for short distances with the assistance of a standard bariatric walker. The use of a walker was also recommended by physical therapy to help with unloading of the right lower extremity due to high pain levels. The patient had limited dexterity through his upper extremities due to the combination of stiffness

from the motorcycle accident (subjective report from the patient) and his obesity. Following seven years of wheelchair confinement, the patient developed a knee flexion contracture on the left of 25 degrees. In addition, the patient had severe bilateral hip stiffness limiting his ability to achieve a neutral hip position in the sagittal plane in standing and in the prone position. This resulted in great difficulty reaching proper alignment and optimal posture when standing.

The patient was outgoing and enjoyed meeting and spending time with fellow patients on his floor. A collaborative team-based approach of health care was delivered to the patient throughout his rehabilitation at the facility. He received primary care from a licensed nurse practioner, and received nursing and restorative nursing care throughout the day. In addition to physical therapy, the patient was also seen by occupational therapy, recreational therapy and psychology. The orthopedic surgeon who assisted with the patient's amputation procedure was accessed as a resource at times when needed by physical therapy or by the patient himself. The patient utilized and enjoyed recreational therapy as a form of entertainment and rehabilitation throughout his length of stay.

CHAPTER III

INTERVENTION

Initial physical therapy sessions emphasized education. Prior to the amputation, the patient was issued a copy of "The Next Step", a handbook written by clinicians and rehabilitative team members in the Department of Veterans Affairs and Department of Defense. This book provides patients with education on the journey following an amputation procedure. Following the procedure, the patient continued to receive verbal education on various topics including the importance of weight loss in order to provide an optimal environment for prosthetic fitting and use. Education was also provided in the form of demonstration for proper independent donning of his elastic shrinker sock. Throughout therapy, he received consistent verbal education on the steps involved with rehabilitation following an amputation including what to expect once he received his prosthetic limb and what he could likely anticipate moving forward as an individual with an amputation in regards to mobility and residual limb care. This education occurred approximately 2-3x/week.

The patient's pre-prosthetic training after the amputation procedure began with two neuromuscular reeducation interventions for desensitization purposes to the residual limb including mirror therapy for 15 minutes at every treatment session and tapotement by the physical therapist. Both of these interventions continued throughout the entirety of patient's therapy regimen. For optimal shaping and volume reduction of the residual limb, the patient

was given an elastic shrinker sock two weeks post-amputation and was able to downsize at week three post-amputation. Significant gains in level of force tolerated by the patient during tapotement were seen throughout therapy. Initially the patient could only tolerate very gentle touching/tapping around the incision site, with progression to forceful hitting/slapping by approximately 2-3 weeks post-amputation as sensitivity decreased in the residual limb.

Therapeutic exercises included: ambulation, bed mobility training, low-load long duration stretches to bilateral hips (Thomas stretch) and to the left knee. Mat exercises included isometric and concentric strengthening to the right residual limb into hip extension and hip adduction to promote optimal ROM and prevention of hip flexion and abduction contractures, short-arc quad exercises on the left to promote knee extension and bridging to promote hip extension. The patient progressed rapidly through the use of the parallel bars and was independent in the use of a bariatric standard walker by two weeks post-amputation. The patient also progressed rapidly in his bed mobility and was independent by week two post-amputation. He was also able to tolerate going into the prone position on the mat by week two post-amputation, which indicated to physical therapy that it was appropriate to incorporate concentric hip extension exercises into the patient's strengthening regimen. Mat strengthening exercises continued throughout the entirety of the patient's time in therapy until discharge.

Approximately three weeks post-amputation, discussion of the patient's prosthetic limb prescription became more serious. This resulted in intensified treatment to the left knee flexion contracture. Treatments consisted of various low-load long duration stretching techniques with the use of a pulley-system and counterweights, and manual overpressure combined with contract-relax techniques by physical therapy. All stretching techniques were combined with

the addition of moist heat at the beginning of the treatment session. At week twelve post-amputation when little to no progress with these stretching techniques was seen, physical therapy ordered the patient to wear a Dynasplint at night to assist with the goal of gaining knee extension.

Proper alignment with full extension through bilateral hips and through the left knee upon standing was the goal before the arrival of the patient's new prosthetic limb, though this was not achieved. As the patient's residual limb was the optimal size in terms of volume and the incision was fully healed, physical therapy and the physical medicine physician reached the decision to move forward with the process of obtaining a prosthetic limb.

To ensure the health care team had a comprehensive grasp on the patient's left knee flexion contracture, a referral to orthopedics for imaging was placed after discussion with the physical medicine physician. These images showed severe osteoarthritis with no structural blockage limiting the lower extremity's ability to obtain full knee extension. This left physical therapy to believe that poor home program compliance with the Dynasplint and severe tissue inextensibility were contributing factors to the failure of achievement of full knee extension.

CHAPTER IV

OUTCOMES

The patient had an AKA with comorbidities including morbid obesity, hypertension, and anxiety as well as a history of narcotic/opioid abuse. A left knee flexion contracture of approximately 25 degrees and a 15 pound weight gain during hospitalization contributed to the outcomes. The patient was primarily using a wheelchair for long distance mobility and a standard walker for short distances prior to his amputation, which were unchanged until the patient received his prosthetic limb. Prior to receiving his prosthetic limb, the patient remained constant at the following FIM scores: Chair to bed transfers: FIM=6; Ambulation: FIM=5 (housebound exception) at 50-75 feet; and Stairs: FIM=1 (not attempted). As reported by occupational therapy, the patient was independent in his ADLs after set-up: FIM=5. The patient continued to have difficulty cleaning himself after a bowel movement (BM) and declined to work with the occupational therapist on improving his shoulder ROM.

To assist in the development of the patient's plan of care including selecting the type of prosthetic components for an individual following an amputation, Medicare has a developed a classification system, The Medicare Functional Classification Level (MFCL). This classification system is used as a guideline to influence the choice of components that will ultimately come together as the patient's prosthetic limb. A patient's individual ability or their potential to ambulate and navigate their environment is described by a designated K-level as defined by

Medicare.[15] A particular K-level is used in determining which prosthetic components will be covered by Medicare. Descriptions on each K-level can be found in Table 1.[15] The patient had a classification K2 K-level amputation. An individual who has a K2 classification is described as "having the ability or potential for ambulation with the ability to traverse low-level environmental barriers such as curbs, stairs or uneven surfaces." This individual is summarized as a typical community ambulator.[15] For an individual classified as a K2 level, rehabilitation in preparation for a prosthetic limb will have the ultimate goal of functional and effective ambulation with a new prosthetic limb.

Table 1.

The Medicare Functional Classification Level K-Levels

K-Level	Description	Foot/Ankle Assemblies	Knee Units
K0	This patient does not have the ability or potential to ambulate or transfer safely with or without assistance and a prosthesis does not enhance their quality of life or mobility.	Not eligible for prosthesis	Not eligible for prosthesis
K1	This patient has the ability or potential to use a prosthesis for transfers or ambulation on level surfaces at fixed cadence - a typical limited or unlimited household ambulator.	External keel, SACH feet or single axis ankle/feet	Single-axis, constant friction knee
K2	This patient has the ability or potential for ambulation with the ability to traverse low-level environmental barriers such as curbs, stairs, or uneven surfaces - a typical community ambulator.	Flexible-keel feet and multi-axial ankle/feet	Single-axis, constant friction knee
K3	The patient has the ability or potential for ambulation with variable cadence - a typical community ambulator with the ability to traverse most environmental barriers and may have vocational, herapeutic, or exercise activity that demands prosthetic use beyond simple locomotion.	Flex foot and flex-walk systems, energy storing feet, multi-axial ankle/feet, or dynamic response feet	Fluid and pneumatic control knees
K4	The patient has the ability or potential for prosthetic ambulation that exceeds basic ambulation skills, exhibiting high impact, stress, or energy levels - typical of the prosthetic demands of the child, active adult, or athlete.	Any ankle foot system appropriate	Any ankle knee system appropriate

The patient progressed very well in the rehabilitation of his residual limb. The shape of the residual limb and healing of the incision were both favorable, and the patient was compliant in the diligent use of his elastic shrinker sock removing it only to bathe. This compliance allowed the patient to be fit and measured for his prosthetic limb in a timely manner. The patient reported significant reduction in phantom limb pain five weeks post-amputation. The patient was skeptical of the use of the mirror therapy, but with the significant decrease in his phantom limb pain he stated that it must have been working and continued to complete this part of his pre-prosthetic rehabilitation until the arrival of his prosthetic limb.

The patient received his prosthetic limb three months post-amputation. This resulted in an increase in physical therapy from twice a day to four times a day, incorporating gait training with the prosthetic limb at every treatment session. The patient's primary method of mobility remained his wheelchair when not in therapy. Difficulty donning his initial gel prosthetic liner led to a switch to a Silesian belt system to increase the patient's efficiency donning his prosthetic limb.

The patient was eventually discharged to an assisted-living facility approximately twenty weeks post-amputation for a total length of stay of approximately twenty-two weeks. Upon discharge, the patient achieved a FIM score of 6 (previously 5) for ambulation reaching a distance of 170' with a standard walker and his prosthetic limb. The patient's inability to complete self-care activities of daily living, such as cleaning self after a BM, necessitated discharge to assisted living. The patient chose to remain in the city where he received his amputation and physical therapy treatment despite having no social support. The patient

explained he wished to stay close to the health care professionals in order to receive prosthetic limb maintenance if/when needed in the future.

Upon follow-up with social work, the patient had not been successful following discharge and continued to have difficulties completing self-care activities of daily living due to limited range of motion through his upper extremities. He also experienced frustration donning his prosthetic limb resulting in limited use. Throughout the patient's time in therapy, he was always grateful for physical therapy services but did get discouraged with the slow progress, occasionally stating he wished he had never gone through with the amputation. The largest sources of frustration were his physical limitations such as morbid obesity, decreased shoulder, hip and knee ROM, and decreased endurance.

Multiple factors worked against this patient's success with a prosthetic limb. The patient's morbid obesity impaired his aerobic capacity and endurance. He also demonstrated limited strength and mobility in his left hip following the previous THA. These factors combined restrained the amount of time spent gait training in treatment sessions. The patient's morbid obesity also impacted the prosthetic manufacturing due to weight limitations on the prosthetic components. Another hindering factor was the left knee flexion contracture and bilateral hip stiffness leading to improper alignment in standing. Lastly, the patient had psychosocial factors that had a large influence on physical therapy treatment. The patient had moderate to severe anxiety, depression, very limited to no social support and a history of substance abuse. These factors combined greatly influenced the success of treatment by limiting physical therapy's ability to effectively educate the patient. The patient repeatedly demonstrated lack of understanding and noncompliance.

CHAPTER V

DISCUSSION

While all physical therapists want the best outcomes for their patient, sometime factors outside the physical therapist's scope of practice inhibit the patient's success. The patient in discussion had multiple factors working against achieving an optimal level of use with a prosthetic limb. Perhaps the most debilitating was the left knee flexion contracture of 25 degrees. This consumed a large portion of the patient's pre-prosthetic rehabilitation and deterred physical therapy away from incorporating other areas of strengthening that were equally important. Many individuals with different types of impairments can benefit from the initiation of core stabilization exercises. However, core stabilization exercises were never a specific intervention that were utilized with this patient during pre-prosthetic rehabilitation. Given the multiple barriers this patient had to overcome after the amputation procedure, the integration of an aggressive and deliberate core stabilization regimen would have been beneficial to the patient's success with a prosthetic limb.

Throughout therapy, this patient experienced negative thoughts and would sporadically state that he regretted the amputation. The patient was appreciative of the integration of new interventions into his plan of care as he was willing to try anything to help him achieve his goal of being able to return to functional mobility. Outside of therapy, the patient had difficulties with compliance and motivation demonstrated by a 15 pound weight gain and limited use of

the Dynasplint. In order to participate in activities that require short bursts of high-intensity or long-duration endurance activities, a strong core is required. [22] By strengthening the core, an individual can experience increased efficiency and agility, and reduce the chance of injury throughout their daily activities.[22] By incorporating core stabilization exercises the patient may have benefited psychologically and physically, having a greater chance for optimal outcomes.

Individuals with an AKA have increased energy expenditure.[18] In conjunction with the AKA, the patient also had to battle the left knee flexion contracture. When fully extended, the knee is able to bear weight without constant muscular energy. When a knee flexion contracture is present, a large amount of energy is needed from the quadriceps to support body weight and remain stable.[23] Another obstacle that impeded this patient's pre-prosthetic rehabilitation was the previous left THA limiting the amount of time spent weight bearing post-amputation due to limited strength and mobility. Strong core musculature would have been supplemental and valuable to assist this patient in decreasing the amount of energy that he was expending due to the knee contracture and weakness from previous surgical interventions such as THA.

This patient had a multitude of factors working against his achievement of his long-term goal of independent ambulation. While he did not achieve this goal, implementation of an aggressive, specific and deliberate core stabilization program may have increased the chances for success. After this experience, it is this author's recommendation that all pre-prosthetic rehabilitation regimens should include the diligent use of core stabilization exercises to provide the patient with the best possible chance of success with a prosthetic limb.

Another key element absent during this patient's pre-prosthetic rehabilitation was the use of a diagnosis specific functional assessment such as the AMP. The patient was assessed

with FIM scores throughout his time in therapy, but was never formally assessed with a diagnosis specific functional assessment. The addition of the AMP into this patient's rehabilitation may have more accurately identified his specific limitations. Identifying and recognizing these specific deficits early in his care may have promoted a more tailored rehabilitation program and aided in providing a more comprehensive and individualized plan of care. One benefit of the AMP is the ability to administer the assessment prior to amputation. As the patient made the decision to amputate, it may have been beneficial for him to have had objective data explaining his functional ability and the prediction of whether or not he could be successful with a prosthetic limb post-amputation.

Individuals with an amputation experience a multitude of limitations after the procedure including significant neurologic and musculoskeletal changes. The use of a diagnosis specific functional assessment can identify areas of deficits and strength. As amputations can be a psychologically taxing procedure for an individual, identifying their strengths may be invaluable. As such, a functional assessment such as the AMP is highly recommended as a key element of a patient's pre-prosthetic rehabilitation to ensure that their plan of care is as individualized and comprehensive as possible.

While key elements of a pre-prosthetic rehabilitation were absent from the case in discussion, parts of the rehabilitation were successful and are worth mentioning. Many individuals with an amputation experience phantom limb pain after their procedure. For some, this part of the rehabilitation after an amputation can be debilitating possibly requiring medication or even surgical intervention. The patient in this case report did experience phantom limb pain and phantom limb sensations, but not to the level of severe impedance on

full participation during pre-prosthetic rehabilitation and eventual use of a prosthetic limb. It is believed that the diligent use of mirror therapy throughout the patient's pre-prosthetic rehabilitation significantly helped in the reduction of phantom limb pain.

The patient's progress in desensitization was an area of rehabilitation that saw significant improvement. At the beginning of pre-prosthetic training, the patient was able to only tolerate gentle touching and tapping of his residual limb. By three weeks post-amputation, the patient was able to tolerate moderately hard taps on his residual limb. These were significant gains in desensitization and greatly contributed to the patient's full participation in therapy and timely progression to prosthetic limb training. The patient was compliant on the wearing of his elastic shrinker sock which allowed for optimal shaping and volume reduction of his residual limb. This was another key factor to the progression of timely measuring and fitting a prosthetic limb.

In conclusion, many key elements must be present in a successful pre-prosthetic rehabilitation program. The overview provides a list of recommended pre-prosthetic rehabilitation key components for an individual with an AKA. While this patient was not as successful as he had hoped for in regards to independence in functional mobility and in activities of daily living, many valuable lessons were learned through his treatment. The inclusion of a diagnosis specific functional assessment in developing a comprehensive and individualized plan of care as well as the importance of core stabilization exercises are important lessons to take away from this case report. The implementation of these foundational aspects towards the development of an individual's pre-prosthetic rehabilitation regimen would be instrumental to helping patients succeed with the use of a prosthetic limb.

Overview.

Key Elements for an Above-Knee Amputation Pre-Prosthetic Rehabilitation

- Residual limb shaping (use of ace wrap and/or an elastic shrinker sock)
- Residual limb desensitization
- Scar mobilization
- Phantom limb sensation and phantom limb pain therapy
- Functional assessment of patient with a diagnosis specific measurement tool (AMP)
- Range of motion and contracture prevention exercises (contraction of residual limb musculature)
- Transfer training
- Core stabilization exercises
- Upper extremity strengthening and mobility
- Cardiovascular exercise
- Strengthening of the sound limb
- Patient education starting pre-amputation when possible and continuing throughout care.

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